NASA ADVISORY COUNCIL

HELIOPHYSICS SUBCOMMITTEE

April 15-16, 2013

NASA Headquarters
Washington, DC

MEETING MINUTES

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Maura Hagan, Chair

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Jeffrey Newmark, Executive Secretary

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Day 1: Monday, April 15

Welcome, Overview of Agenda
Dr. Maura Hagan, Subcommittee Chair, opened the Heliophysics Subcommittee (HPS) meeting. The meeting was open to the public; some people were connected by telephone.

Committee members introduced themselves.

Dr. Hagan reviewed the agenda and offered to entertain any comments or suggestions for modifications. Dr. Jeffrey Newmark, HPS Executive Director, explained that most of the first day would be spent in discussion of the Roadmap. Hearing no suggestions for modification, Dr. Hagan said the subcommittee would proceed as planned. She asked Dr. Newmark to speak.

Heliophysics Division Overview/Flight Program Status
Dr. Jeffrey Newmark

Dr. Newmark reviewed the status of the Heliophysics Division's (HPD) four programs: Explorers, Solar Terrestrial Probes (STP), Research, and Living with a Star (LWS). These programs have three main thrusts: to solve fundamental mysteries, to understand the nature of our home in space, and to understand space weather.

Highlights:

- Two new explorer missions are planned. These will be an advancement for heliophysics.

- The Ionospheric Connection (Icon) Explorer is to explore the boundary between Earth and space. It has been learned recently that ionospheric space weather is driven not only by the Sun but also by Earth weather. ICon should provide data related to this new discovery. Icon Explorer is has just finished its phase A study and is now entering phase B. Its schedule will be developed over next few months.

- Global-scale Observation of the Limb and Disk (GOLD), a mission of opportunity (MoO), is the first flight on a commercial satellite. This is a new platform and an inexpensive way to get into space. The mission is an imaging spectrograph, a very capable instrument.

GOLD and ICon together will be a powerful advancement in understanding the ionosphere. The goal is for both to launch around 2017. These two missions work together, so it will be of benefit to launch them as close together as possible, but they are selected separately based on their merits and feasibility.

Dr. Newmark discussed new performance goals, whose wording had been worked out through the science planning team. There was an effort to make level of wording uniform, with a goal of a 12th-grade reading level. This document is an effort to communicate not just with NASA science staff but also with the public as well as Congressional staffers what HPD is trying to achieve. It was developed in consultation with the Roadmap Committee.

The sounding rocket program has a campaign to launch sounding rockets all over the world. In recent years, however, there has been combustion instability with the rocket motors, a result of an "improvement" the manufacturer made a few years ago. Because of this problem, there are new requirements; if a rocket misses a certain window at the 25-second mark it must abort its mission. Over the past 14 years, 98 percent of rockets have gone through this window. The manufacturer is returning to the old design.

Dr. Newmark reviewed plans for heliophysics missions in FY 2013 – FY 2018. Regarding planned missions, Dr. Desai explained that CubeSat, which has a 2-year development, needs a "ride." He also discussed the Clouds and Earth's Radiant Energy System (CERES) mission, in which there had been two separate instruments, one to measure energetic electrons from 5 kV to 200 kV, and another to measure from 500 kV up. The decision was made to create a single instrument to measure electrons at all energies in a circular orbit and high inclination, looking specifically at microbursts in the radiation belt, but also capable of measuring solar energetic electrons in the polar region.

Regarding the Balloon Array for Radiation-belt Relativistic Electron Losses (BARREL) program, Dr. Newmark talked about the successful campaign to observe electrons coming down from below the Van Allen Probes. Some of the balloons stayed up for about 2 weeks. Dr. Newmark commented that BARREL has another campaign, another twenty balloons launching next winter in Antarctica, when it will be summer there.

For the Magnetospheric MultiScale (MMS) mission, Dr. Newmark explained that the optocoupler parts have had some screening issues and are being investigated. Dr. David Klumpar explained that the mission's high-voltage power supplies use these parts and push them to their limits. The failure rate is 1 percent to 2 percent. The concern is that failure is unpredictable; the investigation is to find out if there is a way to see which ones are prone to failure. The problem, Dr. Newmark said, has to do with the behavior of chips, switching the voltage on and off.

Dr. Schrijver asked about Solar Orbiter, a joint project between the European Space Agency (ESA) and NASA, and whether there is a formal understanding of the open data policy. Dr. Newmark deferred to Dr. Madhulika Guhathakurta, who explained that there is a proprietary period. Dr. Schrijver pointed out that NASA makes its data available almost immediately, typically within minutes. He asked why this policy is not reciprocal: NASA may have to wait half a year or a year for data from others. Dr. Newmark pointed out that HPD is on the forefront of providing quick access to data and needs to provide other parties a reasonable time to check data. It has been recognized, Dr. Schrijver commented, that there is mutual benefit in an open data policy. Could this process not be started for Solar Orbiter? Dr. Guhathakurta said there would be more dialogue on the issue.

According to ESA, Dr. Guhathakurta said, Solar Orbiter is notionally due for launch in January 2017. She explained that even in international Living with a Star, where it is agreed that data will be made available, NASA meets with resistance in trying to obtain data. NASA continues to put pressure on agencies. The White House Office of Science and Technology Policy (OSTP) is working on this. Dr. Charles Swenson commented that the subcommittee had made a formal finding suggesting that international agreements be entered into only if their data policy is open. Dr. Hagan said this should be discussed the next day.

Dr. Swenson asked to see a chart showing the status of flight missions. Dr. Newmark showed one (It had not been included in the presentation). He explained that there is a "desirement" to have a 15 percent reserve in a mission's budget; without that, there is risk of not being able to launch as planned.

Dr. Newmark explained that the Interface Region Imaging Spectrograph mission (IRIS) was at risk because its reserves were low due to issues that arose shortly before launch. Just before launch, for any mission, any small issue will stress the budget. Dr. Swenson commented that the draft Roadmap puts forth the idea that missions led by a principal investigator (PI) do not run into budgetary trouble. This mission is PI led; therefore it is germane to understand why there was not enough budget margin for its final phase. Dr. Desai asked for updated numbers. Dr. Newmark replied that the total lifecycle cost would not be known until after launch. Asked for support for the notion that PI-led investigations stay within budget better than do center-led missions, Dr. Newmark referred to a paper from Aerospace Corporation investigating the question.

A new law shifts matters related to ITAR [?] from being regulated by the Department of State to being regulated by the Department of Commerce, but the effect of that is not yet clear. Responsibility in this area is personal, not institutional, so a violator could go to prison. Dr. McPherron raised two examples of Chinese students doing supercomputer simulation who had been forbidden access to the files they needed, and could not make their presentations. Dr. Hagan said there were 52 cases in which accounts belonging to people from out of state were frozen; users could not get their data. Dr. Guhathakurta commented that the freezing of accounts

happens suddenly; retroactive steps take a long time. Dr. Newmark commented that the issues with the Chinese national who was a contractor at Langley must have influenced NASA's decision about how to handle these cases, since that person was arrested.

Dr. Newmark commented that Dr. Edward DeLuca would be present for only the first day of the meeting for a discussion of the Roadmap. Before the meeting, committee members had been sent a draft of the Roadmap. In reviewing the Roadmap, Dr. Newmark asked members to consider the big picture. Did it capture what members thought it should?

Dr. Hagan commended Dr. DeLuca on his and his team's hard work on the Roadmap. Larry Kepko, the Committee's Co-chair, and Mihir Desai, a Committee member, were present.

Heliophysics Roadmap Overview
Dr. Edward DeLuca, Chair
HP Roadmap Committee

Dr. DeLuca explained that in drafting the Roadmap, the Roadmap Committee had followed the science priorities of the Decadal Survey report. Thus the Research and Analysis (R&A) program and DRIVE initiative had the highest funding. For missions, science targets were followed and support for the Space Environment Testbed (SET) program had highest priority. There needs to be flexibility within the document because budgets are tight and the future is unknown. The Solar Terrestrial Probe line may change.

There was discussion about the distribution of PI-led, cost-capped, and limited-science missions. A PI leading a mission has flexibility to make necessary trade-offs to stay within the cost cap as things change. But a PI alone may not be able to manage a $500-million mission. In that case there can be teaming.

The draft Roadmap budget, based on assumptions from NASA Headquarters, is less optimistic than the budget in the Decadal Survey report.

The Roadmap's top level objectives are what is most often seen by people outside; therefore, that section's wording is important. Some wording changes have been made from the 2009 to the draft 2013 version. There is less about safeguarding the journey and more about forecasting space weather.

HPD is responsible for forecasting space weather outside the Solar System. A different agency is officially responsible within the Solar System. There are transitions to be developed within the next 5 years in HPD as to where the balance of resources is going. HPS is a good place to articulate what the vision going forward should be.

Dr. Schrijver commented that expanding and accelerating the HPD Explorer program was the second priority from the Decadal Survey. Augmentation, if it happens, will happen after FY 2018. Dr. DeLuca replied that the Decadal Survey's top priority is to finish the existing missions. The only way those can fit in the profile is at the expense of the Explorer program. Dr. Schrijver replied that the Decadal Survey had assumed (1) that budgets would be at least corrected for inflation; and (2) that the solar probe has not grown. Several people said the Solar Probe had in fact not grown. Dr. Schrijver said that from this presentation it looked like it had grown from $100 million in the Decadal Survey to $250 million in the FY 2018 Roadmap budget. There was discussion about whether this change was real or just a result of the way things were broken out.

Dr. Karpen asked whether the Roadmap budget took into account the President's budget, which had come out recently. Dr. Kepko said it did, except for late, minor changes. Dr. Swenson asked what the current budget number for Solar Probe Plus was. Dr. Kepko said he thought it was $1.38 billion but was not sure. Dr. Hagan asked him to take that question as an action item.

Dr. Desai asked whether ICON's and GOLD's selection as Explorer projects addressed Dynamic and GDC goals. Dr. Newmark replied that it addressed many of them. Dr. Desai commented that flexibility plays a big role; this meant that the Magnetosphere Energetics, Dynamics, and Ionospheric Coupling Investigation (MEDICI) could be pushed forward. Dr. Kepko added that the Roadmap is an opportunity to show that the Explorer line is being used as strategic science. There was agreement that at most a paragraph should be devoted to this Roadmap addition.

Dr. DeLuca pointed out that the LWS program would be losing future missions; there are huge implications to having the flat budgets projected in the strategic program. Flexibility is a keyword: NASA must take advantage of every opportunity, like missions of opportunity (MoOs). Dr. Guhathakurta questioned why billion-dollar missions were still being planned; she asked if there is a need. Dr. DeLuca replied that the Roadmap Committee's mandate was to follow the Decadal Survey report. The committee had had a very brief time to complete its work; their job was not to fix the budget problem but to modify the Decadal Survey's recommendations in terms of the budget. To do that the committee had to make some assumptions that its members did not really want to make.

Dr. Guhathakurta commented that there are large-scale strategic missions that HPD cannot carry out. She asked why HPD is considering more future billion-dollar missions. Dr. Schrijver agreed with Dr. Guhathakurta that smaller missions are a good strategy. He suggested finding other ways, such as collaboration, to lower the budget. Dr. Newmark agreed. He said the Decadal Survey cannot identify a specific opportunity to collaborate, but it can tell NASA to find such opportunities, such as MoOs and flexible ways of meeting the science targets. A majority of that may be addressed by the new Explorer selection. Dr. Schrijver commented that the Decadal

Survey had addressed cost issues by creating contingencies: "If it goes over *x* cost, then do *y*." This would prevent missions from going so far over budget that they would jeopardize other missions.

Dr. Guhathakurta asked again whether there were program goals that require billion-dollar missions or, alternatively, whether there were strategic goals that could be fulfilled within a certain cost cap. If most program goals can be achieved through PI-led Explorer missions or medium Explorer missions, then they should be done that way. Perhaps the fundamental, strategic science goals whose missions cost $1.5 billion or $2 billion cannot be carried out.

Dr. DeLuca said reference-design missions were outside the purview of the Roadmap Committee. He said these missions existed to address real problems, with solutions that cost real dollars. It was not in the Roadmap Committee's purview to say "This cannot be done." Dr. Schrijver replied that while he did not mean to attack Dr.DeLuca or the Roadmap, it was important that the key conclusion – that the program cannot continue on its present path – be articulated clearly. Dr. Hagan said Dr. Schrijver's point was well taken, but Dr. DeLuca's charge was to note the inherent problems with large, expensive missions given the budget, not to propose alternative kinds of missions. Dr. Newmark commented that Dr. Schrijver wanted only to include text saying that NASA should investigate science through smaller missions, partnerships, and innovative technologies. Dr. Schrijver agreed with Dr. Newmark's interpretation. Dr. Hagan agreed that such an addition to the Roadmap is important.

Dr. Schrijver said it was urgent to communicate in the Roadmap that things do not fit anymore. Dr. DeLuca suggested including that message in a cover letter or in the executive summary; he invited input. Dr. Newmark suggested including that message in the flexibility section.

Dr. Guhathakurta pointed out that when NASA states that strategic missions are growing and cannot be afforded and then shows future billion-dollar missions, there is a disconnect on the community side. Perhaps there are some science goals that are so important that NASA has to invest. Dr. DeLuca said the budget scenario in the context of which the Decadal Survey had made its recommendations was different from budget scenario on which those recommendations were being imposed. Dr. Guhathakurta said there was still a question: If an MMS project is planned at $1 billion and it becomes $1.5 billion, does HPD say it cannot do MMS-class science? Jim [Spann?] agreed with Dr. DeLuca: The Decadal Survey had prioritized the science. With a smaller budget, it might be necessary to chip at the work, say with MoOs; the program should maintain the Decadal Survey's science priority but go about it in a different way, where it is possible to do so.

About the STP program and its management structure, Dr. Desai said the Decadal Survey and the Roadmap tried to give the PI all responsibility except for launch. Dr. Guhathakurta said that is not how the STP program office works, and the difference

needs to be articulated; Dr. Desai agreed. Dr. Schrijver commented that the cost is not in the PI's management but in the superstructure. Dr. DeLuca commented that NASA Headquarters has an issue controlling centers, particularly on the science side. The relationship is complicated, and centers may not follow direction from Headquarters.

Dr. Newmark cited the Aerospace study, which had found that growth in cost was identical for PI-led and Center-led missions. (Some graphs from this paper were included in the Decadal Survey report.) Dr. Guhathakurta cited examples of both kinds of missions, PI led and center led (Solar Dynamics Observatory [SDO] and MMS), with similar cost growth, as well as the Solar Terrestrial Relations Observatory (STEREO), a center-led mission that may be the most cost-effective mission in NASA's history.

Dr. DeLuca cited the problem of supporting the infrastructure while continuing to do discovery science. There are, for example, measurements in L1 that the science community needs for its interpretation of new missions, and there are measurements the forecasting community needs to do its forecasting. But the implementation plan does not provide resources for these observations, and those resources will be hard to argue for, because the discovery space is small. If the community as a whole values these measurements, then the community as a whole must provide resources for them. The Decadal Survey says NASA should have more resources addressing these fundamental measurements. With no new resources, this issue has to be addressed. Dr. Schrijver commented that if there must be in-situ modeling at L1, then there must be multipoint measurements. There is a scientific need and it is not showing up in the Decadal Survey.

Dr. Desai made a suggestion about monitoring on L1. Dr. Jonathan Cirtain asked for clarification: Was Dr. Desai suggesting that a mechanism was needed to replace assets because of the research they provide, or was it that NASA needed to work better with the National Oceanic and Atmospheric Administration (NOAA) to understand how to replace the observational missions? The Interstellar Mapping Probe (IMAP) addressed only the research provided, not the operational data provided; operational data are a NOAA requirement. Dr. DeLuca commented funding rules within HPD are complicated, especially for something that has been done already, even if new data are needed. He said that for these issues, good relationships with other agencies are needed at the Headquarters level. Dr. Hagan said this idea was captured in the draft Roadmap by this text:

> The Roadmap committee strongly supports cooperation between agencies as the only effective strategy for making progress on space weather forecasting during times of tight federal budgets.

Heliophysics Roadmap Chapters 1 – 3
Dr. DeLuca

The Roadmap's first chapter, Dr. DeLuca explained, defines the science through the research focus areas. It addresses high-level science questions. The Roadmap's goals and challenges are expressed as general physical questions.

Dr. DeLuca noted that dynamos are fundamental to everything in the heliosphere. The new draft Roadmap has as a goal the understanding of stellar and magnetic dynamos; the 2009 Roadmap spoke only of magnetic dynamos. Dr. Swenson expressed appreciation for consideration of more kinds of dynamos. Dr. DeLuca noted that the Roadmap Committee's intent was to capture geomagnetic dynamo as well. He said he would take that addition as an action item.

A new research focus areas in the 2013 draft Roadmap was turbulence and waves. Dr. Schrijver commented that the second research focus area, "Understand the plasma processes that accelerate and transport particles," was written as a threat and a danger but also has a positive side, access to heliospheric activity. Dr. Desai offered to redraft that paragraph.

In the research focus areas listed under "understand the nature of our home in space" there had been substantial reworking from the previous roadmap, intended to clarify the distinctions from one element to the next.

In the research focus areas listed under "build the knowledge to forecast space weather throughout the heliosphere," element W3 was "develop the capability to predict the propagation and evolution of solar disturbances to enable safe travel for human and robotic explorers." Dr. DeLuca explained that developing the ability to predict ground-level events had been omitted deliberately. The next element, W4, spoke to ground-level events but did not say "predict." It read "understand and characterize space weather and space climate on and within terrestrial and planetary environments."

Dr. Newmark explained that the intent is for new things that NASA knows how to launch. Where uncertainty lies is in the variability in radiation doses going someplace like Mars. Dr. Schrijver said this tells NOAA, "You do the rest." Dr. DeLuca said it recognizes a situation that exists.

Dr. Jonathan Cirtain expressed concern with the repetitive use of the word "predict," because that seemed to fall within NOAA's purview, not NASA's. Dr. DeLuca replied that the Roadmap was talking about developing capability, and NOAA does not have a mandate to forecast space weather throughout the solar system. Dr. Judith Karpen commented that outside the Earth's sunline, NOAA is not concerned. It is up to NASA to do the research to predict what the Mars rover, for example, is going to

encounter. Further, prediction is essential for testing models; therefore the word belongs there. Dr. Newmark added that the use of the word "predict" was not new to this Roadmap. Dr. Cirtain commented that the line between operational data product and research data product is blurry; it is not clear what is required for NOAA to give a good operational forecast. Using words like "predict" in this context propagates that problem. Dr. Schrijver commented that it was "capability" that was the confuser; "capability" can refer to the hardware, which is NOAA's responsibility. Dr. Robert McPherron said he had worked for 30 years in prediction but never for NOAA and that NASA needs to continue its research. NOAA takes NASA's research products and makes them operational. Dr. Leonard Strachan commented that this wording came from the 2002 Roadmap, in which the writers had said "capability to predict" because they had been directed not to say, simply, "predict." Dr. Hagan commented that these focus areas are about building the knowledge to forecast.

Dr. Klumpar asked whether the Roadmap speaks to transitioning NASA's knowledge over to the operational entities that are going to use it. Dr. DeLuca replied that the current draft does not contain text about "research to operations," but a later version might address the issue chapter 5, which was still in outline form when he spoke.

NOAA, Dr. DeLuca said, discusses interagency roles in its documents. But the Roadmap's jurisdiction does not allow it to say what NOAA should be doing. Dr. Desai commented that the Roadmap committee was careful about wording. Dr. DeLuca added that NASA's ownership of a problem carries the risk that NASA may be told that problem is the most important thing they have to deal with; therefore owning a problem that it should not own may take NASA away from its work and NASA would like to see those outside of NASA doing their part.

Dr. Desai commented that the Decadal Survey had talked about a space weather initiative, a $220 million-per-year program, which Heliophysics cannot afford. The Roadmap notes that this program is important, but not so important that it should threaten other heliophysics missions.

There was discussion about the difference between W3 and W4. Dr. Klumpar expressed concern that NASA not minimize the importance of understanding the science in low-Earth orbit just because someone else is responsible for the operational aspects. Dr. Strachan commented that W4 encompasses other planets besides the Earth.

Dr. DeLuca asked whether W3 was too focused outside the Earth, minimizing the geospace impacts of space weather. Dr. Cirtain commented that one focus area's concern with safe travel seems, from the way it reads, to overlap with the work of the Human Exploration Mission Directorate, which has a funded division at Johnson Space Center. Dr. Cirtain said he understood that it was not the Roadmap's intent to duplicate work, but it might seem to a policy person who is not familiar with the details that it is indeed duplicating work. Dr. DeLuca replied that the science of

space weather prediction is HPD's responsibility. Dr. Karpen said there is a clear transition of information between the work done at Johnson and the work done by HPD.

Dr. DeLuca stated that Roadmap chapter 2 as it stood was at too cumbersome. The plan was to use figures to capture the field with broad brush coverage. It was not a chapter that a typical scientist would read. Dr. Hagan suggested headlines and beautiful pictures with supporting bullets.

If only one or two LWS missions can be launched in a generation then the program may not reach its goal, but may still be held accountable Dr. DeLuca said. Dr. Swenson commented that the program does need to be accountable for what it does. The Roadmap needs to articulate how to make progress on science questions. Within the community, people need to be realistic about what they can do and articulate what they can do and eventually reach the broad goals in chapter 1.

Dr. DeLuca reviewed the draft Roadmap's strengths-weaknesses-opportunities-threats (SWOT) analysis, which included a list in each category. Dr. Schrijver objected to the list of threats to the program, saying that once threats are listed they must be addressed. The overarching principle of the Decadal Survey was system science. If new missions are implemented, some resources will be outdated or no longer available. Dr. DeLuca replied that in the context of the SWOT analysis, strengths and weaknesses are things over which one has some control; over threats one has no control. It is a weakness of the program, he said, not a threat, that new science is dependent on aging infrastructure.

Dr. Desai spoke about chapter 3 of the Roadmap, "Heliophysics, the Program Elements." He said the chapter had been restructured to match the waterfall chart in the Decadal Survey. Most of it was repeated from the previous roadmap; some language was added from the Decadal Survey.

Dr. Swenson asked Dr. Desai to outline objectives for chapter 3, as was done in chapter 1, "Heliophysics: the Science." Dr. Desai that that would be difficult to do in the research program, because it is system level science and research, and should be addressing every challenge that the Decadal Survey laid out.

Dr. Swenson suggested that the Roadmap discuss the elements of the DRIVE initiative individually, since DRIVE is not a formal program. Dr. DeLuca suggested discussing DRIVE at the start of the chapter [? He said "up front"] and then discussing its component parts where the solicitation process, Research Opportunities in Space and Earth Sciences (ROSES), is currently discussed.

Dr. Desai discussed the Explorer flight program. Here the Roadmap deviates from the Decadal Survey's recommendations, but not fundamentally, with MoOs having a more frequent cadence. Dr. Sanchez asked when the next big mission would be,

given that changed cadence. Dr. Newmark answered that the next LWS launch was planned for 2030.

Dr. Sanchez raised the possibility of small missions to replace each big mission. Dr. Desai replied that Explorer is supposed to do that. Dr. DeLuca said the next Explorer is planned for 2016. Dr. Newmark commented that the FY 2015 budget would be NASA's – and Congress's – first chance to respond to any Decadal Survey recommendations, since NASA's opportunity to make requests for the FY 2014 budget had passed before the Decadal Survey report came out. Dr. Hagan said the final version of the Decadal Survey report had been published the week before the meeting.

Dr. Desai explained that in the Roadmap's discussion of STP he and Dr. Newmark were reworking the text for sensitivity to issues with other divisions. [He said "the turf war.']

Dr. Newmark said the highest priority in the Decadal Survey was to look at the outer heliosphere. This was partly so that in-situ observation could be done at the same time as remote sensing. Dr. Schrijver commented that this decision was conditional: If both Voyagers failed, IMAP would not make sense. Dr. Cirtain said doing the missions simultaneously has much more scientific benefit than doing either individually. As LWS missions, Dr. Schrijver said, these missions must be concerned with what comes to Earth. What if the program's Earth resources fail by then?

Dr. Newmark said the Roadmap would talk less about missions in development than about the decision-making process. Dr. DeLuca commented that decisions can be made only if there are resources to support them. Without resources, there is no flexibility. It is a weakness of the budgetary situation that maintaining the infrastructure is challenging, so yes, there is a risk to Orbiter and Solar Probe science from the aging infrastructure.

There was discussion about the level of specificity of science priorities in the Roadmap – Dr. Schrijver suggested perhaps the Roadmap should be more general, a broad statement about ordering priority rather than specific reference to IMAP. The draft Roadmap is specific because the Decadal Survey, on which it is based, is specific. Dr. Newmark quoted a statement [from the Decadal Survey?] that NASA would need to reconsider priorities if circumstance changed. Dr. DeLuca commented that opportunities for adjusting strategic programs are episodic; if they were not, it would not be possible to plan. The next opportunity will be in 2017.

Dr. Cirtain raised the issue of coupled problems. It is difficult to bifurcate responsibilities between agencies. Solutions to some problems depend on data collected outside the Heliophysics program at NASA. HPS has not articulated what those data products are to know what the needs will be. For example, if the Advanced Composition Explorer (ACE) mission ends there is some science that cannot be completed without its data. Dr. Swenson suggested that if the appropriate

monitor does not exist, one can be set up. For example, during energetic solar events, ACE fails to work but Wind does work. Dr. Klumpar commented that another agency cannot be relied upon for data the program needs, because others will build according to their own requirements, not the Heliophysics Program's. Dr. Swenson commented that with true cooperation both sides contribute funding and each side has some control. "Would you please do something for me" is not partnership.

The draft Roadmap recommends that STP missions be PI led. Dr. Klumpar asked for clarification of the connection between STP's focus on fundamental science as opposed to LWS's focus on life and society, on the one hand, and PI-led missions v large missions on the other hand. Dr. DeLuca replied that the management choice of PI v. center is an implementation issue, not a property of the program. Dr. Newmark explained that with missions of this size, there is no reason for the extra layer of interaction that would result from having the mission managed by a center. He said the same reasoning would apply to LWS missions; perhaps elements of the draft Roadmap needed to be broken out differently to show that the statement that missions should be PI led applies to LWS as well as STP.

There was discussion of PI-led v. center-led mission management. A PI, Dr. Swenson said, studies and puts together a whole package, which goes into procurement. A center-led mission starts with a study and then procures instruments not related to the study. A PI-led mission is far more integrated at the beginning. Dr. Desai added that most PI-led missions do a phase A kind of study, which does not predict accurately what the cost will be, because it is not yet known at that point what will have to be procured. The problem with cost prediction, Dr. Swenson said, is not the project's size but whether the instruments that were studied are the ones that got procured. Instruments on spacecraft often do not match the study or the budgeting that was done.

Dr. Hagan emphasized two points for Dr. Desai in his work on chapter 3:

- It needs to be clear that the flexibility described for the STP program applies to the LWS program as well.
- The Roadmap needs to be clear about what the model is.

Dr. Cirtain asked about what happens to a PI-led the mission after award. In the draft Roadmap, according to the fourth bullet point in the list of specific recommendations for restricting the STP program, each center has the opportunity to execute that mission. Dr. Newmark replied that the Roadmap cannot address mission-to-center relationships and that bullet point will be changed.

Dr. Newmark proposed a back section to the Roadmap on the issue of flexibility in both the STP and the LWS lines. If there are changes in the science and prioritization of any mission there should be the ability to consider changes. Dr. DeLuca cautioned that once Headquarters has been provided with flexibility, they are responsible for decisions – decisions for which it is not always possible to get external community

involvement, because relevant community members may have conflicts of interest. So Headquarters flexibility in some ways removes the community from giving direction. Flexibility is being exercised at the HPD director level; it cannot really be done at community level.

Dr. Klumpar commented that many decisions about where missions are assigned are made above the director level. While HPS can express opinions and offer rationale, HPS needs to recognize that other things come into play.

Dr. Schrijver suggested an international roadmap. Dr. DeLuca said IWS is closest thing the program has to international planning. Dr. Newmark commented that the Decadal Survey's recommendation to offer MoOs as often as possible showed a way to cooperate internationally that does not cost much.

Dr. DeLuca suggested that flexibility can apply to sizes of MoOs. Dr. Newmark said there is no rule specifying the cost of a MoO. Dr. DeLuca said the Roadmap could cover that issue in its general flexibility discussion. Dr. Newmark said MoOs of all sizes would be a good thing.

Heliophysics Roadmap Chapters 4-6
Dr. DeLuca

Dr. DeLuca led the discussion on the rest of the Roadmap. Chapter 4 of the draft Roadmap, on technology development, discusses the strategic program, science targets rather than actual missions. Dr. DeLuca suggested that members review the draft to make sure it communicates fully and correctly.

Chapter 5, addressing space weather and its importance, was just bullet points at this time. This related to Decadal Survey chapter 7. Chapter 5 also discussed agencies and organizations. This was an opportunity to describe what HPD envisions as its role and how HPD will work with other agencies. Chapter 5 would include a new section on the science behind improving forecasting. Dr. McPherron, who had been studying the matter, said he was not sure better forecasting is possible. Forecasting assumes that the solar wind rotates rigidly. Dr. Schrijver said that in fact solar wind changes as it rotates. Dr. Newmark said this was a good illustration of how the communities need to relate to each other.

Chapter 6 of the draft Roadmap addressed education and pubic outreach. But after the Roadmap was drafted, word came out that NASA was no longer to have activities in science, technology, engineering, and math (STEM) education; STEM activities that had been with NASA would go to the Department of Education (ED), the National Science Foundation (NSF), and the Smithsonian Institution. Dr. Newmark said this issue was being addressed at the directorate and agency levels. Dr. Hagan said that under the circumstances it did not make sense to have a chapter focusing on education. Dr. Newmark suggested leaving the chapter in place with a comment saying this is what HPD should be doing, or that HPD should be coordinating with

NSF and the Smithsonian to achieve these goals. The bulk of this chapter could remain, with a preamble recommending that its contents be carried out however the funding gets there. Dr. Hagan commented that the agencies taking over what had been NASA's STEM responsibilities would not receive funding to carry them out. Dr. DeLuca said the implications of the funding change for chapter 6 were still to be determined. Dr. Hagan asked if chapter 6 should have a preamble to state what HPS believes NASA should do in education. On the other hand, she said, that issue might be beyond the NASA. Dr. Swenson suggested deleting text about K-12 education but stating that NASA will continue to do public outreach; will provide products to NSF, the Smithsonian, and ED; and will continue to make materials available that are suitable for other agencies, particularly about space weather. Dr. Hagan added that NASA could continue to show taxpayers that this is what they get for their dollar.

Dr. Cirtain pointed out another impact of this change: The use of education money was a criterion in Senior Review. Dr. DeLuca said this had ceased to be a criterion the week before, with the new policy. Chapter 6, he said, is readable. Removing sections from it is straightforward. Dr. Newmark said there needs to be agreement on a strategy. The decision could be to remove K-12 education from the document, or it could be to note that these issues are pending review. He suggesting asking Dr. Jeffrey Hayes for an opinion; Dr. Hayes would be at the meeting the next day.

Dr. Schrijver commented that HPS needs to coordinate with Human Exploration, especially regarding instruments on and off the International Space Station (ISS). Those are opportunities that do not require full missions.

Dr. Newmark commented that the Moon and the Earth are one system. NOAA is responsible for studying that system toward Earth. In terms of predictive capability, there will be international overlap. Dr. Hagan suggested restating the issue in terms of partnerships.

Heliophysics Roadmap Summary
Dr. Edward DeLuca

Dr. Hagan noted that this was HPS's opportunity to imprint the Roadmap. Dr. Newmark asked members to bring up any issues they had with it. Dr. Schrijver suggested that the executive summary say: (1) This is HPS's best attempt to implement the Decadal Survey, given budgetary restrictions, and (2) This document contains ideas for how things can be done better if changes can start in the near future.

Dr. Swenson asked if a traceability matrix would be included. Dr. DeLuca said Dr. Kepko and Dr. Larry Paxton would do one. Dr. Swenson suggested a list documenting major missions over 30 years. This would be outreach for people who do not really know heliophysics. Dr. Newmark questioned whether those people would read the Roadmap.

Dr. DeLuca asked when HPS would hold its next meeting. Dr. Hagan said the meeting would take place probably in mid- to late summer; HPS would let Dr. DeLuca know.

Dr. Newmark commented that at its summer meeting HPS would discuss standard performance goals. The next day Dan Woods, director of NASA's Strategic Integration and Management Division, was to make a presentation to HPS on the Science Mission Directorate (SMD) Science Plan. HPS would have a chance to look at the Science Plan, especially the Heliophysics chapter, before the plan was to go to the science committee and then to the full NASA Advisory Council (NAC) in July.

Dr. DeLuca left the meeting.

Dr. Sanchez asked what the next milestone for the Roadmap would be. Dr. Hagan replied that there would be weekly teleconferences to develop a draft for circulation and posting. Dr. Sanchez asked if HPS would meet before then. Dr. Newmark said they would not; HPS members would be sent an improved draft and would have the opportunity to comment. Dr. Sanchez commented that committee members could probably provide important input to the Roadmap committee for the executive summary: how to articulate the conclusions and the need for the paradigm shift. Dr. Hagan and Newmark both encouraged Dr. Sanchez to send his comment. Dr. Hagan said she did not have a timeline for the Roadmap Committee beyond April 2013. She did know that the Roadmap Committee wanted feedback from HPS before they finalized. The Roadmap Committee, she said, had spent a lot of time on chapter 1. Chapter 2 would be completely reworked.

There was more discussion about the costs of PI-led missions v. those of center-led missions. Dr. Desai said the average growth rate for missions of both kinds was 35 percent, but PI-led missions are only about 80 percent as complex as are center-based missions. Dr. Newmark discussed a graph from the Decadal Survey showing flight system cost v. complexity. Dr. Swenson commented that the graph showed a lot of overlap in complexity between PI-led and center-led missions; in other words, even though center-led missions were on average more complex than were PI-led missions, there were many complex missions that were PI led. Dr. Newmark commented that this study said PI missions cost less than did center missions. Examining the data, Dr. Swenson commented that for the average mission, the PI-led missions were less expensive than the center-led missions for the same complexity. (PI-led missions more often fell below the regression line.)

Dr. Cirtrain said it was disingenuous to look at center-led missions, because of differences in the ways costs were calculated. Dr. Swenson said such differences should have been taken into account for the graph. Dr. Newmark said the values in the graph were averages, not medians; if medians had been shown, the graph would have looked different. Dr. Newmark said the graph showed what happens over time: Center-led missions may have gotten better; PI-led missions may have gotten worse. Dr. Swenson said the graph shows that it is always been better to have PI-led

missions. Dr. Schrijver commented that the main driver is the complexity; therefore the best missions are the small, flexible ones. Dr. Newmark said that according to the study, the cost growth from phase B to launch was the same for both kinds of mission.

Dr. Newmark concluded that there are different ways to interpret the data, but giving the PI the benefit of the doubt, it seems the PI-led missions would be somewhat less expensive. Dr. Schrijver commented that the PI must be made a responsible partner. Dr. Desai agreed, saying there must be oversight. Dr. Schrijver cautioned that NASA is losing engineers because they are required to do too many project reviews. Dr. Desai suggested that the Roadmap discuss the possibility of less oversight.

Dr. Swenson raised the issue of how HPD would implement future strategic missions. What was their plan of acquisition? Dr. Schrijver said there is a path to affordable missions. He cited the example of the SUNRISE mission: It has a resolution of one dime 25 miles away and it flies successfully at $25 million. Where is the difference? Dr. Newmark replied that one difference is access to space; the cost of a launch is at least $125 million.

Dr. Cirtain commented that one way to reduce cost is to accept more risk, because risk reduction is expensive. Dr. Swenson said that once a lot of money has been invested, people are less willing to accept risk and mission managers take steps to reduce risk and in so doing spend even more money. Thus as missions become more complex, they cost more and more. Small, low-cost missions can get away with a lot, so they are much less expensive.

Dr. Schrijver commented that the alternative to making things less expensive is being unable to afford missions. Dr. Swenson suggested specifying cost brackets for missions. Dr. Newmark said the Roadmap was doing that implicitly by not including a billion-dollar mission in its budget for the next 20 years. Dr. Hagan said projections of no growth were happening everywhere in the country. There is a paradigm shift. Now budgeting starts with "We have this much money to work with; what can we do with it?" NASA can no longer think that its brilliant ideas are going to bring the funding. This is not unique to NASA.

Dr. Schrijver noted that there are 4 to 5 years between strategic missions and NASA is putting up 15-year-old instrumentation. Dr. Hagan said the first recommendation from the Decadal Survey was to execute the plan, a plan developed in a very different budgetary environment. Can NASA afford to keep the missions?

Dr. Hagan said there is reverse age discrimination at NASA: It is not possible to bring new people in. Dr. Schrijver suggested a study looking at how to bring new people in at low cost. Dr. Newmark noted that the National Research Council's (NRC) Space Studies Board (SSB) might be able to carry out such a study. Dr. Schrijver suggested a study asking an appropriate group of PIs where their cost growth had occurred

and what could be done within a year. Dr. Hagan asked HPS members to think about what kind of study to do. Dr. Newmark suggested a small, directed study, perhaps a workshop. NRC could organize it and hold it at their premises. NRC does not provide summaries, but does collate information. Another possible study would be a white paper produced by SSB. He suggested that Dr. Desai define the white paper.

Dr. Newmark noted that two missions, Solar Probe and MMS, may impact other missions because of cost growth.

There was discussion about the draft Roadmap's budget graph and the bands it showed. Dr. Klumpar said the budget drop was only apparent; someone else said it was caused by the MMS launch. Dr. Hagan said the labeling had to be corrected, so that the graph would not be subject to misinterpretation. She said questions like these would help inform the redo.

Dr. Hagan adjourned the meeting for the day.

Day 2: Tuesday, April 16

Dr. Newmark made note of a change in the agenda: Dr. Woods would speak at 11 am, not 10:30.

Heliophysics Budget
Dr. Jeffrey Newmark

Dr. Newmark showed a table listing FY 2012 funding, the President's FY 2014 budget request, and notional numbers after that through FY 2018, for the Heliophysics Program. The FY 2013 column was blank, unknown because of Sequestration. After that, for the most part, numbers remain flat going out to FY 2018.

Dr. Newmark reviewed what has changed in the budget:

- There are a new Explorer mission (ICON) and new Explorer MoO (GOLD).
- There is a new CubeSat project, which HPD will manage for the directorate. This is a low-cost option for enabling scientific discovery. How it will be implemented has not yet been defined. In the past, CubeSat was competed against other platforms; now it has guaranteed funding for CubeSat.

Dr. Hagan asked whether it was likely that the $5 million budgeted for CubeSat may be augmented in the future. Dr. Newmark said most likely not, because augmenting one program would require cutting a different one, but more CubeSat awards may be made if CubeSat continues to be compete for funding in addition to its guaranteed $5 million.

The main budget feature that has not changed is the mission profile: Budget cuts have not forced changes to existing missions.

Budget details:

HPD lost about $30 million in funding because of Sequestration; SMD, about $180 million. The FY 2014 numbers shown are not as good as they look, because money for other programs is bookkept in the HPD budget. One such item is NASA civil service salaries for all of SMD, that is, salaries for employees who are not paid from project budgets. That amount increased in FY 2013. Dr. Hagan asked why the NASA civil service funding varies from year to year. Dr. Newmark explained that the number is a pre-allocation; it will not be used if employees are paid from projects, but if that happens, that funding is removed from the budget. Dr. Hagan asked why that funding was not the same in the out years. Someone answered that in out years, that funding gets moved to a different division.

Dr. Swenson asked if there was some way to leverage the money designated for sounding rockets and for the research range at NASA's Wallops Flight Facility – two budget lines that are overhead-type costs – against the $5 million in the CubeSat. Dr. Newmark replied with caution: To make that work would require support from Wallops. Wallops needs funding for its staff, and the facility may need an upgrade. It would be a negotiation. Dr. Newmark suggested another possibility: Perhaps STMD [?] could run the CubeSat program through its program at Ames Research Center. At present, all CubeSat launches were being done at Kennedy Space Center. Perhaps the same staff were the right people to run the new CubeSat program.

Dr. Karpen asked why the budget for the Community Coordinated Modeling Center decreased $0.5 million between FY 2012 and FY 2014. Someone answered that it was split into two pieces; integrated, it has not changed much.

Dr. Schrijver remarked that the Voyager budget, $5.3 million, was enough to pay at least 20 people funded to keep an ear on Voyager. Someone replied that the Voyager allocation paid for seven people and various other things. The Voyager program is maintaining old machines; this is costly. They have been given an augmentation to bring in one or two young scientists. Dr. Schrijver commented that $5.3 million for Voyager seemed out of proportion to the $2 million budgeted for the Solar and Heliospheric Observatory (SOHO). Dr. Swenson explained that Voyager consists of two spacecraft built a very long time ago, when spacecraft needed a lot of operators. There was an effort to upgrade, but it damaged the spacecraft, and since that time there have been no further efforts.

Dr. Newmark explained that the budget also contains "parked" funding for the National Space Science Data Center (NSSDC) for science data and computing; this funding – accounting for $2.1 million in the FY 2014 budget – is used mostly by the Planetary Science Division. In addition, 1 percent of the total Heliophysics budget

(about $7 million) is set aside, on the NASA Administrator's request, for the Administrator's reserve fund. This is in addition to 1 percent set aside already, for a total of 2 percent.

Dr. Hagan observed that there was a carve-out of $5 million for the CubeSat program, which seems to be paid for with funding from the Guest Investigator (GI) program. Dr. Newmark said the way the budget works is more complex than that: Things had been added and subtracted in several places. The total budget was down $30 million in FY 2013 from FY 2012. Dr. Hagan paraphrased her question: What was the explanation for the reduction to the GI program? Dr. Desai said the GI program had gone into LWS science, which had an increase. Dr. Hagan said that if the program is losing funding it must be a lower priority. Dr. Newmark said the budget had been developed before the Decadal Survey was released; therefore the Decadal Survey was not available for reference at the time and its priorities could not be taken into account.

Dr. Swenson asked Dr. Newmark what would happen if mission operations and data analysis (MO&DA) funding disappeared from the program lines. Dr. Newmark replied that the numbers shown were notional. If Senior Review gives a mission a high rating, the program will find funding for it.

Dr. Desai asked about NASA's role for Hinode: Does NASA just manage it? Dr. Newmark replied that NASA runs the two instruments on Hinode and provides significant support for the third. A lot of the cost is for operations. Dr. Desai questioned the amounts shown for the Interstellar Boundary Explorer (IBEX): $1.6 million in FY 2012 and $3.7 million in FY 2014. Someone confirmed the numbers and explained that the project, coming out of phase D, was below cost so the program removed that funding from the budget.

Dr. Sanchez asked what impact Sequestration would have on research. Dr. Newmark replied that as far as he knew, Sequestration applied only to FY 2013. There would be no impact on competed research grants for FY 2013. It did seem, Dr. Hagan commented, that Sequestration would affect travel as well as education and public outreach (EPO). Someone said it would affect meetings as well; he was holding meetings via WebEx.

Someone else said there had been an article in *Physics Today* saying there was an increase in the Heliophysics Research budget. Clearly that was not true.

<u>Science Mission Directorate Science Plan</u>
<u>Dan Woods, Director, Strategic information and Management</u>

Mr. Woods said the last Science Mission Directorate Science Plan, issued in 2010, was a great document; therefore, he was using it as a basis for the next plan, due out in the 2014. The new plan would take into account the national agenda and its driving priorities.

Within the new draft plan are principles, strategies, and challenges. The 2014 plan will include one new principle and one new strategy beyond those in the 2010 plan. The new principle is: "Strategic decisions for future missions and scientific pursuits are driven by priorities recommended in the NRC decadal surveys and informed by national needs." The new strategy is: "Design and successfully implement programs that accomplish breakthrough science and applications."

One strategy that would carry over from the last version had to do with STEM education. Dr. Hagan asked if, given the expected change in NASA's education activities, that strategy was still evolving. Mr. Woods said it was. He said he believed that whether it gets funded it is the question.

Mr. Woods invited participants to let him know, through Dr. Newmark, if something in the Science Plan needed to be changed.

Dr. Schrijver noted that heliophysics missions are expensive; he asked if there are ways to do them less expensively? Since the time of the last Science Plan in 2010, the financial situation had changed tremendously.

Dr. Newmark raised the issue of how the Decadal Survey, the Roadmap, and the Science Plan should align together. The Science Plan, as the only purely NASA document of the three, should reflect the community. Mr. Woods replied that the people working on the science plan had not yet dealt with this question. He encouraged Dr. Newmark to see how the 2010 Science Plan had handled it; the 2014 plan would do something similar. The Agency has three strategic goals: space, Earth, and agency excellence. The specific strategic objective for heliophysics is "Understand the Sun and its interactions with Earth and the Solar System."

Mr. Woods wanted to be sure HPS was in agreement with the heliophysics strategic objectives and science goals. He requested feedback before the following Thursday, April 25. He said he could provide HPS with an update when he sent the document to the NRC.

Mr. Woods said his goal was to provide a draft of the entire science plan in July.

Senior Review Discussion
Dr. Jeffrey Hayes, Program Executive for Mission Operations and Data Analysis

Senior Review is required every 2 years by act of Congress. The next Senior Review was scheduled for April 23-26. Fourteen missions were coming into the senior review.

In the past, Senior Review was done as a best practice, but the requirement has become law. The biggest change in Senior Review is that Dr. Hayes has asked the missions for prioritized science goals over the next 5 years, as well that missions

plan to a 5-year budget horizon. For FY 2014 and after, EPO money for mission and grants has been zeroed out.

Dr. Hayes referred to the President's budget, which Dr. Newmark had discussed, and said the numbers in it were not real; the budget had been decreased by $30 million already and was likely to decrease more. Dr. Swenson commented that the process is difficult and fuzzy, and the absence of a budget makes it worse. In the entire science portfolio of the HPD, something may have to be turned off. Getting consensus to do that will be difficult.

Dr. Hagan commented that the panel makes a recommendation and Dr. Hayes makes a decision. Dr. Hayes added that after him the decision goes to Vicky [?] and then to Dr. John Grunsfeld, Associate Administrator for the Science Mission Directorate. Dr. Newmark commented that Dr. Grunsfeld is very engaged. Dr. Hayes said his (Dr. Hayes') desire was to keep as much running as possible, especially what makes sense scientifically.

Dr. Cirtain commented that proposers are being requested to address EPO metrics against which they cannot be judged because funding is unknown. Dr. Hayes replied that the chair of the EPO panel will state what the panel's recommendations would be if funding were available. This information will be useful if funding becomes available.

Dr. Cirtain commented that mission operations (MO) will lose funding this year because of Sequestration, and probably budget reductions after that. He asked how it is possible to plan with so much uncertainty. Dr. Hayes replied that he can only plan for the snapshot he can see. Dr. Hagan suggested a prioritized list. Dr. Hayes said the last Senior Review agreed with that idea, breaking projects into three groups according to priority.

Dr. Hagan asked what mechanism could be developed by which there could be outsourcing from the agencies to which EPO activities had been transferred back to NASA because of NASA's expertise. Dr. Hayes replied that there is a desirement to do that, but it seemed the policy had been put in place without regard to how the funding could be flowed back to NASA. Dr. Swenson asked what had happened to the $46 million that had been taken from NASA STEM programs. Dr. Hayes said he believed it had gone mostly to the Smithsonian Institution. In effect, NASA funding had been turned into STEM funding.

Dr. Swenson asked what would happen to the funding for the James Webb Space Telescope once the project was complete. Dr. Hayes replied that NASA has sacrificed from other project budgets to make this one succeed despite overruns, and the project had impacted the Astrophysics Division's budget. The funding does not return to HPD. This was an expensive, technically challenging mission entailing risks and politics. The project may succeed, but it may consume funding for heliophysics projects in the out years.

Dr. Desai pointed out that Planetary Science Division had also lost a lot of funding: $1.4 million last year and $1.2 million going forward. He asked if any restoration was expected. Drs. Newmark and Hayes both answered No. Dr. Newmark noted that there is a process to request a budget increase: Propose it, it gets shot down, refine it. The process typically takes 1 to 3 years.

Dr. Newmark commented that one reason Solar Probe is having a more extensive phase B than a typical mission is to retire risk so that when it comes up for confirmation it will have a believable life cycle cost. Dr. Hayes said a project that has never been done before and is a one off will be expensive. Dr. Schrijver commented that the telescope project is redirecting the community. Dr. Desai and Dr. Hagan commented that the Decadal Survey had recommended that once started, a project should be finished, despite cost overruns.

Dr. Hayes discussed NASA's response to the President's desirement for open data. He said SMD is prepared in that regard. He suggested inviting Dr. Marc S. Allen, Director for Strategic and International Planning, to talk about how NASA could provide access to a journal for which public funding has been used for some of its contents. Dr. Schrijver said one board of the NRC had looked into that and estimated that it would cost 20 percent of the Agency's budget.

Dr. Cirtain said the way the centers obtain journals varies from center to center. He said there is discussion about archiving the post-review, pre-publication version of any article that a civil servant has authored or coauthored and making it publicly available about a year after publication, regardless of what journal publishes it. Dr. Hagen asked if it was possible to mandate that people publish only in publications that have open access. Dr. Newmark replied that doing so might put NASA at risk of being sued for hindering the business of publications that require pay. Dr. Hagan said there might be enough interest to invite Dr. Allen to come talk at HPS's next meeting.

Dr. Hayes talked about how NASA leverages its partners for access to their data. This is a challenge, because the partners view their data as their intellectual capital, while NASA believes that the more people look at the data the better the science is. It's "my data" as opposed to "the government paid for it." Heliophysics has an open data policy. But different data are in different formats, and some may be hard to post. The best NASA can do is lead by example. To make one's work useful and to see it disseminated, one must make some aspect of it public.

Dr. Newmark commented that internationally one must go mission by mission, but within the United States NASA is setting up policies. By presenting its data within 12 minutes of obtaining it while others hold onto theirs for 6 months, NASA can set an example. Dr. Hayes referred to a standard clause in memoranda of understanding: "Both sides will make their data public as fast as reasonably possible." It has worked, even if dissemination has not been as fast as NASA would have liked.

Dr. Hagan commended the group for a good discussion.

Heliophysics Competed Research Program
Dr. Arik Posner, Heliophysics Research and Analysis Lead

The various ROSES programs have a low rate of success over a growing number of submissions.

ROSES is being restructured. In the searches for volunteers for review panels, a new method is being used: Instead of being called one by one and asked to volunteer, potential reviewers are being sent to an online form that asks about availability and conflicts of interest. Many potential reviewers have volunteered.

For the DRIVE initiative, in accordance with the Decadal Survey, the R&A program has put in place vehicles for more funding. Dr. Swenson commented that this seems like an effort to increase the R&A program. Dr. Posner replied that HPD has the lowest percentage of competed R&A among the divisions. Dr. Swenson questioned the wisdom of growing the number of the researchers in the field, given the budget situation. Dr. Posner replied that DRIVE had recommended putting adequate funds into R&A. Dr. Newmark commented that without this augmentation, the community would shrink.

Dr. McPherron commented that there is an increasing population writing proposals; this is driving the success rate down. Dr. Posner commented that a decreasing percentage of graduates in the field are finding positions.

Dr. Newmark quoted the Decadal Survey as saying that for a new mission, HPD may not have the expertise required for all the possible research. With a dedicated GI program there would be funding for such research. The Decadal Survey had said 2 percent for each mission should be set aside for data analysis; therefore, a mission that would have been costed at $500 million should instead be costed at $510 million, with the additional $10 million designated for data analysis.

Dr. Posner discussed some ROSES problems and their solutions. One such problem is the submittal of very slightly different proposals to several programs within 1 year. This wastes reviewers' time. The proposed solution is to restrict programs by excluding focus opportunities from general programs. The intended effects are to reduce the review burden on the community, to increase the success rate, and to accelerate the review process. Dr. Desai commented that the intent seemed to be to keep one proposer from submitting to several programs simultaneously.

Another proposed change would be a two-step proposal submission process, with proposing teams not allowed to change between step 1 and step 2. Step 1 would replace the notice of intent. If proposals are not competitive, proposers would be so informed in step 1 and would be discouraged (but not prohibited) from going

through with step 2. Dr. Hagen cautioned that the word "discouragement" invites misinterpretation. Dr. Swenson commented that it is important to have access to qualified reviewers for review panels. With the present system, anyone who submits a notice of intent cannot be on a review panel; if proposers who stop after step 1 become unavailable as reviewers, there may not be enough reviewers. Dr. Newmark commented that the two-step process had been tried in an experiment the year before and 90 percent of the people who submitted step 1 also submitted step 2, with the result that only a small number of would-be reviewers who ultimately did not propose got ruled out. Dr. Swenson replied that the 10 percent who were lost as potential reviewers were important. Dr. Posner said they would not be lost; step 1 proposers who do not submit step 2 become eligible to serve as reviewers.

Dr. Desai referred to an experiment done on a similar two-step proposal submission process in a planetary data analysis program. The finding was no correlation between those whose step 1 proposals were or were not deemed worthy of encouragement, on the one hand, and those who went on to step 2, on the other. There was disagreement between Dr. Posner and Dr. Desai as to whether the step 1 judgments were communicated to proposers.

Dr. Schrijver said HPS had discussed this issue two meetings ago. For a proposal's merit to be judged, the proposer must list the resources he or she intends to bring and find funding for it. Once that is done, the proposal has in effect been written. With the two-step process, two review panels would be needed.

Dr. Hagan asked how it would be decided, based on the pilot test, whether the two-step process was worth pursuing? Dr. Posner replied that the final disposition – fundable and not fundable – of the two categories of step 1 results – encouraged and discouraged – would be compared. How many in each category, encouraged and discouraged, were ultimately found to be fundable? Step 1 reviewers would not be used for step 2, so the experiment would be double blind. Dr. Hagan asked how it could be ensured that a discouraged team does not tweak its proposal and reapply. Dr. McPherron replied that discouragement is done without feedback, without advice as to what was wrong. Dr. Posner confirmed that, but Dr. Desai said discouragement itself is important feedback.

Dr. McPherron commented that young people do not seem to know how to write proposals. Dr. Newmark cautioned about excluding young people from competition, when their proposals may be weak just from inexperienced writing.

Dr. Karpen said that in her experience with this process people who served on step 1 review panels were allowed to be only collaborators on proposals. Dr. Hagan asked whether in that case a proposal team that was established in step 1 could not be changed. Dr. Karpen replied that reviewers were committed before the teams were. Dr. Desai suggested that someone wanting to join a proposal team could excuse himself or herself from the review panel.

Dr. Karpen asked how closely a topic would be examined to see if it fell into an excluded category. Dr. Desai asked, if his proposal was excluded from one category, what he should do. Dr. Posner replied that if a proposal is noncompliant in one area, it should be compliant in another. But there is a gray area.

Dr. Hagan commented that Dr. Posner had gotten quite a bit of feedback from HPS. She said she hoped he would be able to accommodate HPS if they had more questions.

Subcommittee Work Session
Heliophysics Subcommittee

Some HPS members' terms were near expiration; new members would need to be brought on board. Dr. Hagan said Dr. McPherron was willing to extend his term for another year at most. Dr. Newmark commented that Dr. Hagan's term would end on May 14, 2013, Dr. Jeffrey Hughes' term would end in 2014, and Dr. Karpen's termwas over. Dr. Karpen said she was willing to extend her term through one more meeting. Dr. Newmark said that Drs. Shrijver and Strachan had completed completed their terms and that he had extended Dr. Swenson's term for one year.

Dr. Newmark hoped to have three or four new members on the subcommittee by the time of the upcoming July meeting. More new members would be on board by fall. Pending that, he said, a letter would go through Dr. Grunsfeld to extend the terms of willing members, including Dr. Sanchez, Dr. Schrijver, and Dr. Karpen.

Dr. Newmark proposed two topics for the agenda for the July meeting: the GPRA Modernization Act (GPRAMA; GPRA is the Government Performance and Results Act) and the Science Mission Directorate Science Plan. He said he would send out a draft of the plan once he had it. The heliophysics part of the plan is seven pages long. Dr. Newmark asked if those topics could be covered in 2 days. Several people said it would take 2 ½ days to cover those topics. Dr. Hagan advised erring on the side of caution, because the subcommittee would have to cover the GPRAMA in its entirety. The next meeting's dates were set for July 16 thru noon on July 18.

Dr. Desai asked if the Roadmap would be discussed at the next meeting. Dr. Hagan said feedback on the Roadmap was due that day, April 16. There would be one more draft on which HPS would be asked to comment, but that would be outside of the meeting cycle. Dr. Newmark said HPS would not be a committee looking for findings after the present meeting. This day would be the only time the committee would produce findings on the Roadmap.

Dr. Hagan discussed potential findings. Both Dr. Strachan and Dr. Schrijver had proposed findings addressing the cost of strategic missions.

Dr. Newmark said the Geospace MAWG [?] had said they had a number of findings. He had asked them to come talk. They had said their findings had to do with HPD, and did not need to go up to the NAC system. HPS's findings, Dr. Newmark said, can be for the Division only or can be for the Agency level, in which case they would go up to the NAC system. Dr. Hagan asked to be copied on the MAWGs' proceedings. Dr. Newmark said he would arrange for her to see them. Dr. Desai asked about the MAWGs' leadership. Dr. Newmark said the MAWGs had had a steering committee, which provided findings and thoughts to HPS. They were working on a review of the 10 years of the LWS program. It would be a good presentation for HPS.

Dr. Desai suggested a one-paragraph executive summary in the Roadmap reflecting the meeting's discussion on cost. Dr. Guhathakurta's approach, asking whether the program needed to have billion-dollar missions, would give the community a better chance to address the science goals. He also expressed appreciation for Dr. Strachan's summary of the points the group had discussed.

On the issue of PI-led heliophysics missions v. "Battlestar Galactica," [I think he means enormous missions] Dr. Desai said the compiled data [for all of SMD?] that HPS had seen did not provide much useful information; Dr. Desai would like to see separate data on heliophysics. Dr. Newmark offered to ask the paper's authors to highlight the heliophysics data. Dr. Desai said that with that information HPS could better frame a request to SSB for a study. Dr. Newmark questioned whether heliophysics missons would be different in this regard from missions in other communities. Dr. Desai replied that one would need to see the data to be sure there was no difference. Dr. Hagan agreed. Dr. Newmark agreed to request the data.

The discussion moved to the open data policy. Dr. Swenson said the problem is with international missions. He suggested reemphasizing the policy. Dr. Sanchez questioned whether anything would be gained by that; it is not that the PI does not want to release the data. Dr. Desai replied that sometimes it is: European PIs are much more protective of data than are American PIs. European PIs are not required by their government agencies, which fund their instruments, to make the data public. Dr. Newmark said that an open data policy presentation held in February 2012 concluded that NASA's open data policy has been very successful.

Dr. Sanchez suggested that at the next meeting the findings of the past few years be read for incoming members. Dr. Newmark suggested that incoming members be directed to the HPS website. Dr. Hagan confirmed that findings were posted there. Dr. Schrijver said the latest findings there were from February 2012. Dr. Newmark said he would update the website.

Dr. Hagan asked for clarification about whether there would be action on the open data policy. Dr. Newmark noted that Dr. Schrijver had sent it out a year ago and there was no reason to restate it. Dr. Hagan quoted from minutes from the February 2012 HPS meeting: "The HP data policy is working. Nearly all data from active missions is accessible . . . " There was no record of a finding from that meeting. Dr.

Newmark commented that Dr. Barbara Giles had still been executive secretary in 2012.

Dr. Swenson offered to take the lead on keeping the HPS website up to date with findings. Dr. Hagan asked Dr. Swenson evaluate any draft recommendation on the topic of open data that HPS had made in the past, if Dr. Newmark was able to find such a recommendation. Dr. Swenson said he, Dr. Schrijver, and Dr. Strachan would look for the old draft. If none of them could find it, he would draft a recommendation.

Dr. Swenson commented that collaboration does not work if data is not made available to the community promptly, even if it does become available eventually. Dr. Schrijver said it will become increasingly evident that science is a rapid-response sport. To have to wait for your partners to publish is a competitive disadvantage. Dr. Swenson said NASA understands that data should be available. But some NASA people want exceptions to the open data policy. Dr. Newmark said there is no absolute length of time after which data should be available; it should be "as soon as possible." For example, IBEX releases 6-month maps, so it makes no sense to require data within days. Dr. Schrijver said the proprietary data period should be as short as it can be. That is separate from the collection period. Dr. Hagan said Dr. Swenson would draft a recommendation on the topic later that day, on his flight home. She told HPS members that she would need their input by close of business on Wednesday, April 17, for the NAC meeting the following week.

Dr. Swenson referred to information from Dr. Posner's presentation about service centers in the HPD budget making HPD's allocation look bigger than it is. He suggested that the Roadmap list services that HPD provides to the rest of SMD. Dr. Hagan agreed. Dr. Sanchez said people needed to see that there is money in the HPD budget that HPD cannot use.

Dr. Swenson left the meeting.

Dr. Desai raised the flexibility issue, related to the Roadmap. He had written something about it, which he said he would send out to members the next day.

Dr. Schrijver asked for someone to edit something he had drafted on budgets. Dr. Strachen offered to do it.

Dr. Karpen raised the issue of space weather program and its status. The language used to describe it, she said, is pejorative. There is no dedicated funding or infrastructure. This is a gap that needs to be addressed. Dr. Hagan said Dr. Karpen's point was a good one and the Roadmap committee would welcome something on it.

Dr. Schrijver said operational requirements should be dictated by those who need to operate. Dr. Karpen replied that many partners are involved. Dr. Schrijver said that in a partnership both parties put something of value on the table. But the other side

is not quite doing that. Dr. Newmark said it is being done at a low level; there is a memorandum of understanding. Dr. Karpen said there are a lot of complications and dialogue is needed. Dr. Hagan agreed, saying the stakeholder does not know what they want; they just know that what NASA is providing is not it. Dr. Newmark cautioned against talking too much to the end user, because that could mean circumventing the Agency. Dr. Hagan asked Dr. Schrijver to draft something on the topic.

Dr. Newmark proposed a finding that HPS was endorsing the general body of the Roadmap. Dr. Hagan replied that that HPS has reviewed the Roadmap, endorses it, and is suggesting refinements. Dr. Karpen asked how HPS can endorse the document when they have not yet seen the final. Dr. Schrijver clarified: HPS is happy with the process but has not yet seen the product. Dr. Newmark said the issue was timing; this meeting was HPS's opportunity to approve the Roadmap. Dr. Hagan explained that the endorsement would mean HPS accepts the provisional recommendations, such as that the program follow the Decadal Survey. Dr. Schrijver objected, saying there are things in the Roadmap that HPS does not endorse. Dr. Hagan said that in terms of process, endorsement would have to be done through e-mail. Dr. Newmark said that because HPS is a committee under the Federal Advisory Committee Act (FACA), the endorsement would have to be done at a meeting. But the Roadmap Committee did not want to wait until the HPS meeting in July before they could disband. Dr. Sanchez suggested a teleconference. Dr. Newmark said that could work; it would be an official meeting. He said he would look into it.

Dr. Newmark asked what a study would provide and what information the Roadmap could take into account. The Aerospace paper concluded that growth of mission cost was identical overall between PI-led and center-led missions. There was a shrinking 20 or 24 percent cost differential, with PI-led missions less expensive. Some of that differential seemed attributable to the complexity factor, but even for some missions of the same complexity, PI-led missions tended to be less expensive. Authors of the study said they would dig deeper.

Dr. Schrijver said the Roadmap's concern was cost growth. The solution they proposed was not necessarily supported. Dr. Hagan said that just because it is in the Roadmap does not mean it will happen. Dr. Schrijver replied that even so it was not a good thing to have an invalid conclusion in the Roadmap. Dr. Newmark asked if the Roadmap should be on hold; several people replied that it should not. Dr. Sanchez said the Roadmap should offer flexibility. Dr. Schrijver agreed, saying it would be better if the decision between PI-led and center led were made mission by mission. Dr. Hagan said this could be the basis of a Roadmap finding. The complexity factor should be the determinant. There is nothing magical about $1 billion or $500 million; it is really the complexity factor that determines mission cost.

Dr. Newmark said another point in favor of PI-led missions is that they allow the smart community to come up with innovative ways of achieving the science. Dr. Schrijver explained that the creative process is different for the two different

management systems. It is not one person that applies for a center-led mission. Dr. Sanchez said there would have to be strict cost limits and Dr. Hagan agreed. Dr. Newmark said there had been a finding at the last meeting endorsing NASA's new cost growth applications. Dr. Newmark said that PI-led missions in the past had been Life Explorers, New Frontiers and Discovery, for which there is no science and technology definition team (STDT). He suggested forming an STDT to optimize the science and the payload. It might be possible to develop a hybrid of the two models. Dr. Strachan, who had served on STDTs, agreed that forming one would be a good idea. Dr. Newmark said that was what the Decadal Survey had in mind: NASA would determine a science target but might need help working out its details.

Dr. Hagan asked how HPS would endorse the final version of the Roadmap. Dr. Newmark said he would look into having a teleconference. Before the July meeting the new graph would be added to the Roadmap and the Roadmap Committee would disband. Dr. Karpen suggested that the Roadmap Committee not disband before the July meeting. Dr. Hagan said committee members had committed themselves until April at the latest. Dr. Newmark said the Roadmap Committee had done an amazing amount in the time they had. Dr. Hagan said the work had been expected to be quick and easy because the Decadal Survey was supposed to be perfect. But it turned out to be otherwise.

Dr. Allen came to the meeting during the last 10 minutes. Dr. Hagan invited him to make a presentation at a future meeting and he agreed to do so at the next meeting. Dr. Newmark told Dr. about HPS's question on data policies.

Dr. Allen summarized NASA data policy issues: About 2 months earlier, OSTP had released a guidance memo directing agencies to take action to facilitate free, open, and easy access to publication and research data. When the policy was released, after the election, NASA had 6 months to deliver a plan for implementation. The effort was operationalized through two working group at NASA Headquarters: Dr. Teresa Fryberger is leading the effort on the publication side. The National Institutes of Health (NIH), which has had a statutory requirement to do just this since 2008; has developed PubMed Central. On the data side, NASA would not have to change much because its space data were already available. Issues remain; for example, the policy calls for scientific digital data and the scope of that is not clear. Although this will be a major undertaking, it is not intractable. There are copyright issues, which OSTP is addressing. NASA wants to use NIH's system; how to do that has not yet been worked out. The deadline is NASA internal concurrence by the end of June, with NASA's policy due to OSTP 30 days after that.

Dr. Hagan thanked Dr. Allen for the update.

Dr. Newmark adjourned the meeting.

Appendixes

Appendix A – Attendees

Heliophysics Subcommittee Members

Maura Hagan, Chair	**National Center for Atmospheric Research**
Jeffrey Newmark, Executive Secretary	**Heliophysics Division, NASA Headquarters**
Mihir Desai	Southwest Research Institute
Judith Karpen	NASA Goddard Space Flight Center
Robert McPherron	University of California Los Angeles
Ennio Sanchez	SRI International
Karel Schrijver	Lockheed Martin Advanced Technology Center
Leonard Strachan	Harvard Smithsonian Center for Astrophysics
Charles Swenson	Utah State University

NASA Attendees

Marc Allen	SMD HQ
Jonathan Cirtain	HQ/MSFC
Paul DeMinco	GSFC
Tim Gehringer	GSFC
Barry Geldzahler	HQ
Ellen Gertsen	
Madhulika Guhathakurta	HQ
Jeffrey Hayes	HQ
Michael Hesse	GSFC
Jenifer Kearns	
Larry Kepko	GSFC
Mona Kessel	HQ
David Klumpar	HQ
Robert Leamon	HQ
Sheree Marambio	OIIR
Cheryl Moy	HQ
Marian Norris	HQ
Arik Posner	HQ
Diego Sanches	
Jim Spann	MSFC
Jeff Wentz	HQ
Dan Woods	SMD

Other Attendees

Dom Conte	Self
Edward DeLuca	SAO
Jill Hacker	Zantech IT
Jim Lochner	USRA
John McCarthy	Orbital

Amy Reis	Zantech IT

Telephone Attendees

Dan Leone	Space News
Makenzie Lystrup	Ball Aerospace
Stewart Moses	Northrop Grumman

Appendix B – Subcommittee Membership

Maura Hagan, Chair
National Center for Atmospheric Research

Jeffrey Newmark, Executive Secretary
NASA Headquarters

Mihir Desai
Southwest Research Institute

Jeffrey Hughes
Astronomy Department
Boston University

Judith Karpen
NASA Goddard Space Flight Center

Robert McPherron
Institute of Geophysics and Planetary Physics
University of California at Los Angeles

Ennio Sanchez
SRI International

Karel Schrijver
Lockheed Martin Advanced Technology Center

Leonard Strachan
Harvard-Smithsonian Center for Astrophysics

Charles Swenson
Center for Space Engineering
Utah State University

Marion Norris
Management Support Specialist
Science Mission Directorate
NASA Headquarters

Appendix C – Presentations

Heliophysics Division Overview/Flight Program Status, Dr. Jeffrey Newmark
Heliophysics Roadmap Overview, Dr. Edward DeLuca
Heliophysics Roadmap Chapters 1 – 3, Dr. Edward DeLuca
Heliophysics Roadmap Chapters 4-6, Dr. Edward DeLuca
Heliophysics Roadmap Summary, Dr. Edward DeLuca
Heliophysics Budget, Dr. Jeffrey Newmark
Science Mission Directorate Science Plan, Dan Woods
Senior Review Discussion, Dr. Jeffrey Hayes
Subcommittee Work Session

Appendix D - Agenda

Heliophysics Subcommittee Meeting
April 15-16, 2013

Monday April 15; MIC-3A (Room 3H45)

8:30 Subcommittee Room Open	
9:00 Welcome, Overview of Agenda	M. Hagan, HPS Chair
9:15 Heliophysics Division Overview	J. Newmark, NASA HQ
9:45 Flight Program Status	J. Newmark, NASA HQ
10:15 BREAK	
10:30 Heliophysics Roadmap Overview	E. Deluca, Roadmap Chair
11:30 Heliophysics Roadmap Chps 1-3	E. Deluca, Roadmap Chair
12:15 LUNCH:	
1:00 Heliophysics Roadmap Chps 1-3	E. Deluca, Roadmap Chair
1:45 Heliophysics Roadmap Chps 4-6	E. Deluca, Roadmap Chair
3:15 BREAK	
3:30 Heliophysics Roadmap Summary	E. Deluca, Roadmap Chair
5:00 ADJOURN	

Group Dinner

Heliophysics Subcommittee Meeting
April 15-16, 2013

Tuesday April 16: MIC-3A (Room 3H45)

8:30 Subcommittee Room Open

9:00 Heliophysics Budget — J. Newmark, NASA HQ

10:00 Science Mission Directorate Science Plan — D. Woods, NASA HQ

10:45 BREAK

10:30 Senior Review Discussion — J. Hayes, NASA HQ

12:00 LUNCH

1:00 Heliophysics Competed Research Program — A. Posner, NASA HQ

1:30 Subcommittee work session(s) — Subcommittee

3:00 BREAK

3:15 Subcommittee Work Session(s) — Subcommittee

4:00 ADJOURN